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ABSTRACT

To explore the effects of depression and learned helplessness on cognitive task deficits, 66 community-residing elderly adults were categorized as depressed or nondepressed based on Beck Depression Inventory scores. After a pre-test battery measuring short-term memory and components of crystallized/fluid intelligence, the subjects responded to a word association task, disguised as a test of interpersonal empathy, under response dependent or response independent reinforcement conditions, or were assigned to a no treatment control group. A post-test battery composed of alternate forms was then given. The results indicated that elderly subjects exposed to response dependent reinforcement were less likely to display fatigue, helplessness, and/or depression-induced deficits in verbal-auditory short-term memory (forward and backward digit spans). The results suggest that depression and/or helplessness-inducing conditions may exacerbate what might otherwise be relatively slight fatigue effects in elderly subjects. (Author/LLL)

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Depression and Helplessness-Induced Cognitive Deficits in the Aged

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Abstract

Sixty-six community-residing elderly ($\bar{X}$ age=72.5) were categorized as depressed ($\bar{X}$ = 11.3) or nondepressed ($\bar{X}$ = 3.9) based on Beck Depression Inventory scores. After a pre-test battery measuring short-term memory and components of crystallized/fluid intelligence, the subjects responded to a word association task, disguised as a test of interpersonal empathy, under response dependent or response independent reinforcement conditions, or were assigned a no treatment control. A post-test battery composed of alternate forms was then given. The results suggest that elderly subjects exposed to response dependent reinforcement will be less likely to display fatigue, helplessness, and/or depression-induced deficits in verbal-auditory short-term memory (forward and backward digit spans). In general, the results suggest that depression and/or helplessness-inducing conditions may exacerbate what might otherwise be relatively slight fatigue effects in elderly subjects.

Depression and Helplessness-Induced Cognitive Deficits in the Aged

Many authors (Hasher & Zacks, [9]; Hayslip & Kennelly, [10]; Horn, Donaldson & Engstrom, [12]; Hoyer & Plude, [13]) have pointed to the role that deficits in effortful (controlled) processing and/or working short-term memory play in accounting for age decrements in a variety of cognitive tasks. The extent to which such factors as anxiety, depression, and helplessness account for such deficits among the aged (see 9), as importantly as they do among the young (see 1,16,18,19,23) has not been extensively explored.

This study explored the effects of depression and learned helplessness on cognitive task deficits in a community-residing elderly sample. The cognitive tasks (short-term memory and intellectual) were selected to vary in their demands on working short-term memory capacity. Prior research has demonstrated the sensitivity of tasks demanding working short-term memory capacity to anxiety deficits (18,19), depression deficits (9) and helplessness-induced deficits (16) in young adults.

Also, age decrements in fluid, as opposed to crystallized, intelligence have been shown to be largely accountable for by corresponding age decrements in working short-term memory capacity (10,12). Given the relationships between anxiety,

depression and learned helplessness (20) and between depression and aging (4), it was anticipated that measures requiring working short-term memory capacity and fluid intellectual ability would be more sensitive to depression and helplessness effects in an elderly sample than passive short-term memory and crystallized ability tasks, which require less in the way of effortful or working short-term memory capacity.

Method

Subjects and Procedure

Subjects (all volunteers) were sixty-six community-residing elderly ($\bar{X}$ age = 72.5, SD = 6.21), with an average of two years of college. They were recruited from the Dallas-Fort Worth metroplex. All persons saw their health as good, and all were ambulatory.

All subjects were administered (in fixed order) the following scales measuring components of crystallized (Gc) and fluid (Gf) intelligence, short-term memory and depression: vocabulary, abstruse analogies, letter series (11), WAIS digit span (forward and backward), spatial forward and backward memory spans (adapted from Corsi as described in Milner (17) to be procedurally like the digit spans), and the Beck Depression Inventory (BDI).

Based upon normative data for elderly persons using the BDI (8), subjects were classified as either depressed ($\bar{X}$ = 11.3) or nondepressed ($\bar{X}$ = 3.9). Each subject (within levels of

depression) was subsequently randomly assigned to one of three treatment conditions, varying in the extent to which response-reinforcement contingencies were controllable: (1) response independent (RI) reinforcement, (2) response dependent (RD) reinforcement or (3) no treatment control (C). The only restriction on random assignment was that the response dependent reinforcement subject in each triad had to be run before the response independent reinforcement subject since the pattern of reinforcing feedback earned by the response dependent subject determined the feedback received by the yoked response independent reinforcement subject.

The treatment consisted of a word association task of 100 nouns described to the subjects as a test of interpersonal empathy. Subjects were required to give to each stimulus word the association "which most people would associate to it." In the response dependent version of this task, subjects were told "correct," if they gave either of the two highest associates of each stimulus word. In the response independent version, the feedback received was based on the responses of the yoked response dependent subject in their triad (see above). If the response independent subject's response was actually correct but scheduled to be "incorrect," he/she was told "incorrect" and given the other high associate as the "correct" response (see 16,21 for complete description of this task).

Control subjects did not recieve the word association task. All cells contained between 10-13 individuals.

After completing the word association task, all subjects were administered the post-test battery (consisting of alternate forms of the intelligence and short-term memory measures) in the same fixed order as the pre-test battery.

Results

For the word association task, neither treatment, F (1, 41) = 1.52, $p > .10$, depression, F (1, 41) > 1, $p > .10$, nor their interaction F (1, 41) < 1, $p > .10$, had significant effects on the correctness of the word associations. (For the depressed response dependent subjects $\bar{X} = 68.40$; for the depressed response independent subjects $\bar{X} = 62.23$; for the nondepressed response dependent subjects $\bar{X} = 58.08$; for the nondepressed response independent subjects $\bar{X} = 63.40$).

The means and standard deviations for the pre- and post-test batteries of intelligence and short term memory measures are presented in Tables 1 and 2.

~Insert Tables 1 and 2 About Here

For vocabulary, a significant effect for occasion, F (1, 60) = 22.42, $p < .01$, was obtained, in which subjects demonstrated an overall increase in performance pre- to post-treatment. A substantial yet nonsignificant depression X occasion interaction was also obtained, F (1, 60) = 3.17, $p < .08$, with depressed

subjects having smaller pre- to post-test increases in vocabulary scores compared to nondepressed subjects.

Analysis of variance for the abstruse analogies task yielded significant pre- to post-test declines in performance for all subjects, F (1, 60) = 19.94, $p < .01$. In addition, a substantial, yet nonsignificant depression X treatment X occasion interaction was evidenced for abstruse analogies, F (2, 60) = 3.00, $p < .06$, with the greatest decline evidenced among nondepressed subjects in the response independent reinforcement condition.

For the letter series task, there was a significant occasion effect, F (1, 60) = 4.68, $p < .05$, indicating a decrease in performance for all subjects. A substantial but nonsignificant depression X occasion interaction, F (1, 60) = 3.25, $p < .07$, was also evidenced, in which depressed subjects demonstrated a greater performance decline than nondepressed subjects.

For the forward digit span task, a significant overall pre- to post-test decline was obtained F (1, 56) = 3.84, $p < .05$. Moreover, there was a main effect for treatment, F (2, 56) = 5.10, $p < .01$ (with RI subjects scoring the lowest and RD subjects scoring the highest), a main effect for depression, F (1, 56) = 14.84, $p < .01$ (with depressed subjects performing worse than nondepressed), and a significant treatment by occasion interaction F (2, 56) = 7.10, $p < .01$, with subjects in the response independent

condition demonstrating the greatest pre- to post-test decline, F (1, 56) = 11.08, $p < .01$. The control subjects also demonstrated a significant pre- to post-test decline, F (1, 56) = 5.63, $p < .05$, and RD subjects a nonsignificant pre- to post-test improvement in performance, F (1, 56) = 3.66, $p > .05$. At Post-test, the RD subjects outperformed both the RI and the control subjects significantly, $p < .05$, by Newman-Keuls test. The RI and control subjects did not significantly differ by the Newman-Keuls test.

For the forward digit span task, there was additionally a substantial though nonsignificant treatment X depression X occasion interaction, F (2, 56) = 2.96, $p < .06$, revealing that depressed response dependent subjects demonstrated a pre- to post-test increase in digit span performance, while a decline in such performance was evidenced for the depressed control and response independent reinforcement subjects. In contrast, for the nondepressed subjects, only those receiving response independent reinforcement on the word association task demonstrated a pre- to post-test decline in forward digit span performance.

The analysis of backward digit span scores yielded only a significant treatment by occasion interaction, F (2, 60) = 3.68, $p < .05$. Subjects in the response independent reinforcement condition demonstrated the greatest pre- to post-test decline in backward digit span performance,

F (1, 60) = 23.39, $p < .01$, the control subjects the next largest decline, F (1, 60) = 7.03, $p < .05$, and the RD subjects the smallest, F (1, 60) = 1.28, $p > .05$. None of the post-test means was significantly different from the others by the Newman-Keuls test.

While no significant main or interaction effects were observed for either forward or backward spatial memory span tasks, a substantial, F (1, 60) = 2.79, $p < .09$, depression X occasion interaction was obtained for spatial backward memory spans with depressed subjects demonstrating a decline and nondepressed subjects a gain across occasions.

Discussion

The nonsignificant word association test results suggest that neither treatment, depression, nor their interaction affected the correctness of the subjects' word associations. In light of the significant effects of treatment on the post-test battery, the lack of effects on the word associations themselves argues that these associations were probably based on automatic retrieval processes.

The results dealing with helplessness effects suggest that elderly subjects exposed to response dependent reinforcement will be less likely to display fatigue, helplessness, and/or depression-induced deficits in verbal-auditory short-term memory (the digit span measures). Such deficits and their alleviation were <u>not</u> found for the visual-spatial short-term

memory measures. This differential sensitivity of verbal-auditory as opposed to visual-spatial short-term memory measures in the present study may be due to the verbal nature of the helplessness-induction treatment used, a word-association task. Similar reasons for the specificity as opposed to globality of helplessness effects have been discussed by Abramson, Seligman, and Teasdale (2). It is also possible that floor effects operated to a greater degree for the visual-spatial measures. Overall, performance was lower for these measures.

The finding of effects for both digits forward and backward in this study differs from the Kennelly et. al. (16) finding of effects for backward but not forward digit spans in an age homogeneous sample of young adults. Thus, the passive span of apprehension vs. working short-term memory distinction found useful in accounting for test anxiety, helplessness and aging deficits in short-term memory and fluid ability in age homogeneous young adult samples (16) or age heterogeneous adult samples (10,12) may not be applicable to age homogeneous samples of elderly adults. Thus, a neointegration of verbal-auditory short-term memory may parallel the neointegration of fluid and crystallized intelligence in old age (3).

In general, the occasion main and interaction effects on the intellectual and short-term memory measures suggest the operation of fatigue factors on post-treatment performance.

Significant overall declines occurred for abstruse analogies, letter series, and forward digit spans. A number of two- or three-way interactions of occasion with treatment and/or depression for these measures and backward digit spans indicate that these fatigue effects were greatest for those subjects who experienced the helplessness-inducing treatment (response independent reinforcement) and/or depression. Thus, these results suggest that fatigue effects on the intellectual performance of the elderly may be exacerbated by depression and/or prior exposure to conditions which produce helplessness and may be alleviated by conditions which lessen depression and/or induce competence. These results may thus help to explain why fatigue effects on the intellectual performance of the elderly have not always been found to be of significant magnitude (5-7,14,15).

The dependent measure showing the clearest exception to these pre- to post-treatment treands is vocabulary, the best marker for crystallized intelligence in the battery. Vocabulary scores improved significantly pre- to post-treatment. However, even for vocabulary there was a trend approaching significance for the depressed subjects to show smaller improvements pre- to post-treatment than the nondepressed subjects, perhaps due to their inappropriate use of effortful processes to respond to a task requiring relatively effortless, automatic retrieval from long-term memory. It may also reasonably be argued that

vocabulary, coming first in the battery, was least affected by general warm-up effects during pre-treatment and fatigue effects during post-treatment, relative to the other measures.

In light of current cognitive training research in aging (22), these findings suggest that individual differences in pre-existing levels of depression and/or helplessness may mediate the impact of such efforts on elderly persons' cognitive functioning. Moreover, since the test batteries employed in these studies are often quite lengthy, elderly persons who are depressed may be particularly susceptible to resultant fatigue effects.

In summary, these results point to the importance of helplessness and depression as sources of intellectual and short-term memory deficits in community-residing elderly adults. The possible role of depression and/or helplessness in exacerbating what might otherwise be minimal fatigue effects is, in our opinion, especially worthy of further research.

Table 1

Means and Standard Deviations for Nondepressed Elderly Subjects

		Treatment Condition		
		Control	Response Independent	Response Dependent
Measure - Pre-Test				
Letter Series	$\bar{X}$	8.7	9.0	9.0
	SD	3.0	2.9	3.4
Vocabulary	$\bar{X}$	10.9	11.1	11.4
	SD	3.3	2.5	2.7
Analogies	$\bar{X}$	7.6	8.7	7.3
	SD	2.5	2.5	3.7
Spatial Forward	$\bar{X}$	5.6	5.4	5.1
	SD	1.2	.82	.99
Spatial Backward	$\bar{X}$	4.8	4.5	4.8
	SD	1.1	1.1	1.1
Digits Forward	$\bar{X}$	6.4	6.4	6.6
	SD	1.2	.8	1.1
Digits Backward	$\bar{X}$	5.2	5.4	5.0
	SD	1.4	1.0	.79
Measure - Post-Test				
Letter Series	$\bar{X}$	8.6	8.1	9.5
	SD	3.9	3.7	2.8
Vocabulary	$\bar{X}$	12.9	12.4	13.3
	SD	1.9	2.5	2.5
Analogies	$\bar{X}$	6.3	5.4	6.0
	SD	2.4	2.1	2.3
Spatial Forward	$\bar{X}$	5.5	5.3	5.3
	SD	.88	.79	.87
Spatial Backward	$\bar{X}$	5.0	4.6	5.2
	SD	1.2	.93	1.3
Digits Forward	$\bar{X}$	6.4	5.8	6.7
	SD	.97	1.1	.79
Digits Backward	$\bar{X}$	4.8	4.4	5.0
	SD	1.3	.8	1.2

Table 2

Means and Standard Deviations for Depressed Elderly Subjects

		Treatment Condition		
		Control	Response Independent	Response Dependent
Measure - Pre-Test				
Letter Series	$\bar{X}$	9.2	7.8	8.7
	SD	2.4	3.3	3.0
Vocabulary	$\bar{X}$	11.5	11.4	9.9
	SD	1.9	2.7	2.0
Analogies	$\bar{X}$	7.9	5.7	6.8
	SD	3.0	2.6	2.7
Spatial Forward	$\bar{X}$	5.5	5.2	5.3
	SD	1.1	.91	1.1
Spatial Backward	$\bar{X}$	5.3	4.8	4.7
	SD	1.3	1.0	1.4
Digits Forward	$\bar{X}$	6.0	5.8	5.7
	SD	1.4	1.4	1.1
Digits Backward	$\bar{X}$	5.5	5.6	4.7
	SD	1.5	1.1	1.5
Measure - Post-Test				
Letter Series	$\bar{X}$	7.1	7.0	7.6
	SD	2.6	2.5	3.6
Vocabulary	$\bar{X}$	12.2	11.3	11.6
	SD	2.8	2.6	2.8
Analogies	$\bar{X}$	6.6	5.7	5.4
	SD	3.1	2.5	3.0
Spatial Forward	$\bar{X}$	5.5	4.9	5.3
	SD	.85	.74	1.3
Spatial Backward	$\bar{X}$	4.9	4.3	4.8
	SD	.99	.95	1.3
Digits Forward	$\bar{X}$	4.8	4.7	6.6
	SD	.63	.95	.97
Digits Backward	$\bar{X}$	4.8	4.5	4.3
	SD	1.5	.86	1.3

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